Conduit-scale to localized degassing in ascending magmas: Insights from Cl measurements in Vesuvius 79AD pumice

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During the ascent and decompression of magmas that fed the 79AD eruption, melts experienced a complex vesiculation history [1]. Both textural evidence from tephra and conduit ascent modelling suggest that velocity gradients affect the ascending magma column and cause spatial variations in degassing [2]. Localized shearing is one of the dominant mechanism through which these velocity gradients can be accommodated during ascent [3]. These shear zones can enhance bubble connectivity and provide pathways for volcanic gases. Here, we present chemical evidence for spatial degassing variations at the scale of the conduit as well as at localized scale. Because Cl diffuses slower than H2O during ascent, it records a different portion of the magma’s history. Figure 1 below shows Cl increases within denser more degassed zones in 79AD pumice clasts. Through textural observations of vesicles as well as Cl and H2O measurements within pumice glass from various phases of the 79AD eruption, we derive a general conduit model that involves the birth, development, and death of shear-zones.

Figure 1: Compositional map (Cl=blue, K=red, Si=green) made in 79AD pumice. Cl increases towards the denser zone richer in large collapsed vesicles (left) likely due to degassing of H2O. Image width ~ 0.5mm.